Standard Products

Reference Design

Sequenced Power-Up/Down with the Quad Voltage Supervisor

October 2015

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1 Introduction

Cobham Semiconductor Solutions, (formerly Aeroflex) Quad Voltage Supervisor finds use in voltage monitoring, voltage sequencing, and Fault Detection, Isolation and Recovery (FDIR) schemes. Voltage sequencing is particularly common for FPGA and ASIC applications which require a set order to power up the I/O, high-speed I/O and core supplies to prevent contention and high currents. For the same reasons that these applications have power up specifications, they generally require a power down sequence that inverts the order of power up. Current Quad Voltage Supervisors define an order for power up sequencing and maintain this same order during power down. This design reference discusses a method of using MSI logic with Single and Quad Channel Voltage Supervisors to create an intelligent power sequencer that brings power supplies down in the inverse order from power up.

2 Device Features and Demonstration Board

The Intelligent Power Sequencer uses a Cobham Single Channel Voltage Supervisor (UT01VS33D) to monitor a system-regulated, 3.3V rail. Cobham MSI products (UT54ACTS02E, UT54ACTS08E) and a Quad Voltage Supervisor (UT04VS33P) create the sequencer.

Voltage comparators in the Quad Supervisor generate voltage good enables (VOUTx) to sequence the series of regulators. The Quad Supervisor VOUTx signals serve as flags indicating that each monitored system voltage is within tolerance; 3.3V, 2.5V, 1.8V, and 1.2V in this application. The Quad Supervisors RESET/RESETb outputs provide final reset removals after all system voltages are within tolerance.

The Cobham Sequencer Demonstration Board provides hardware for demonstrating the sequencing capabilities.

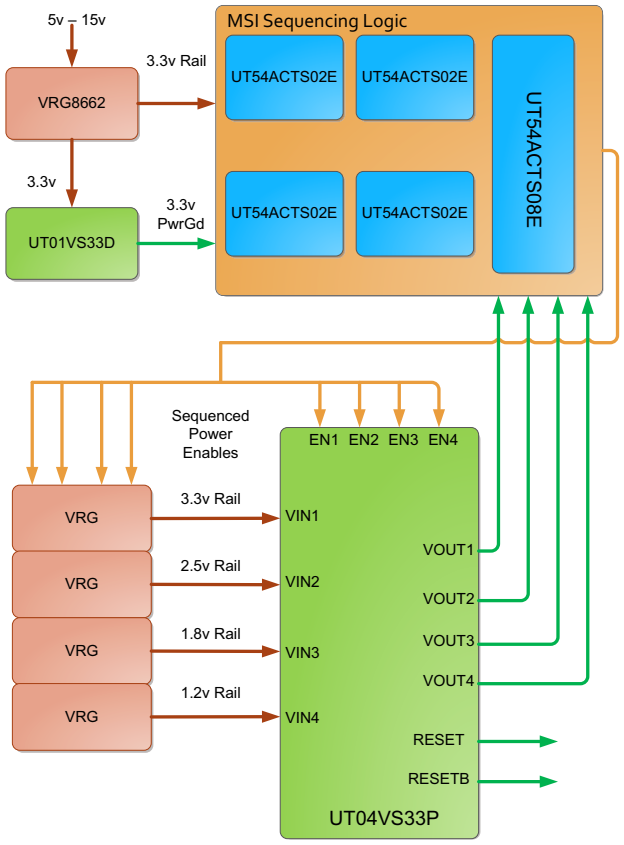


Figure 1. Intelligent Power Sequencer Block Diagram

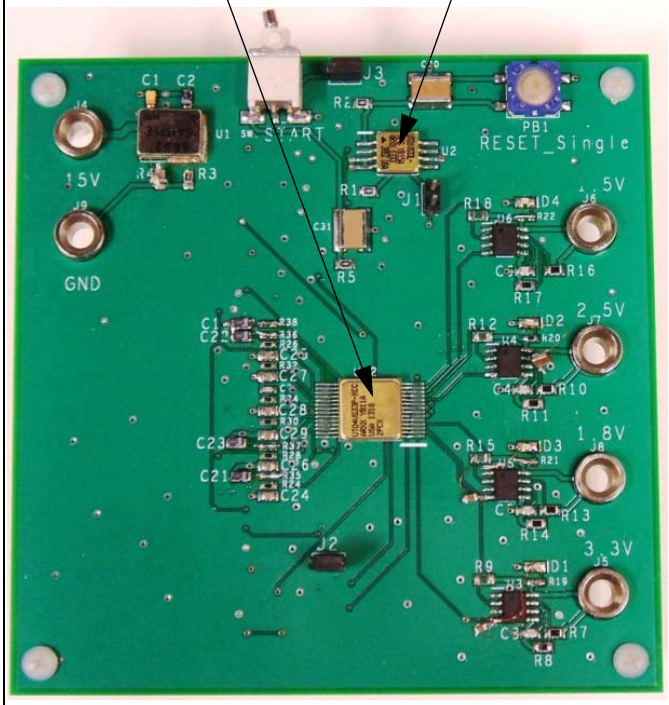


Figure 2. Demonstration Board Front (left)

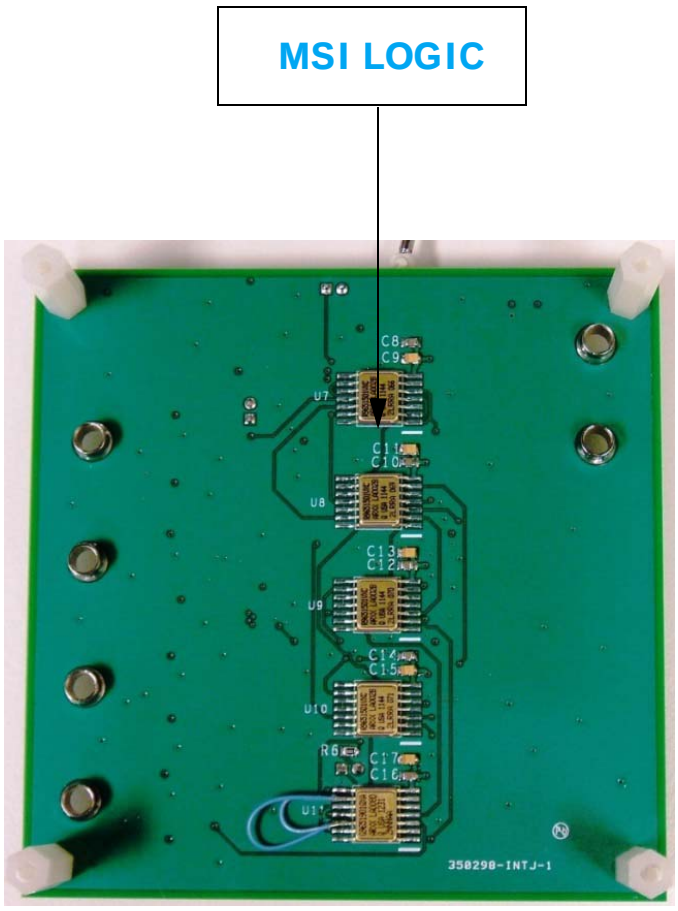
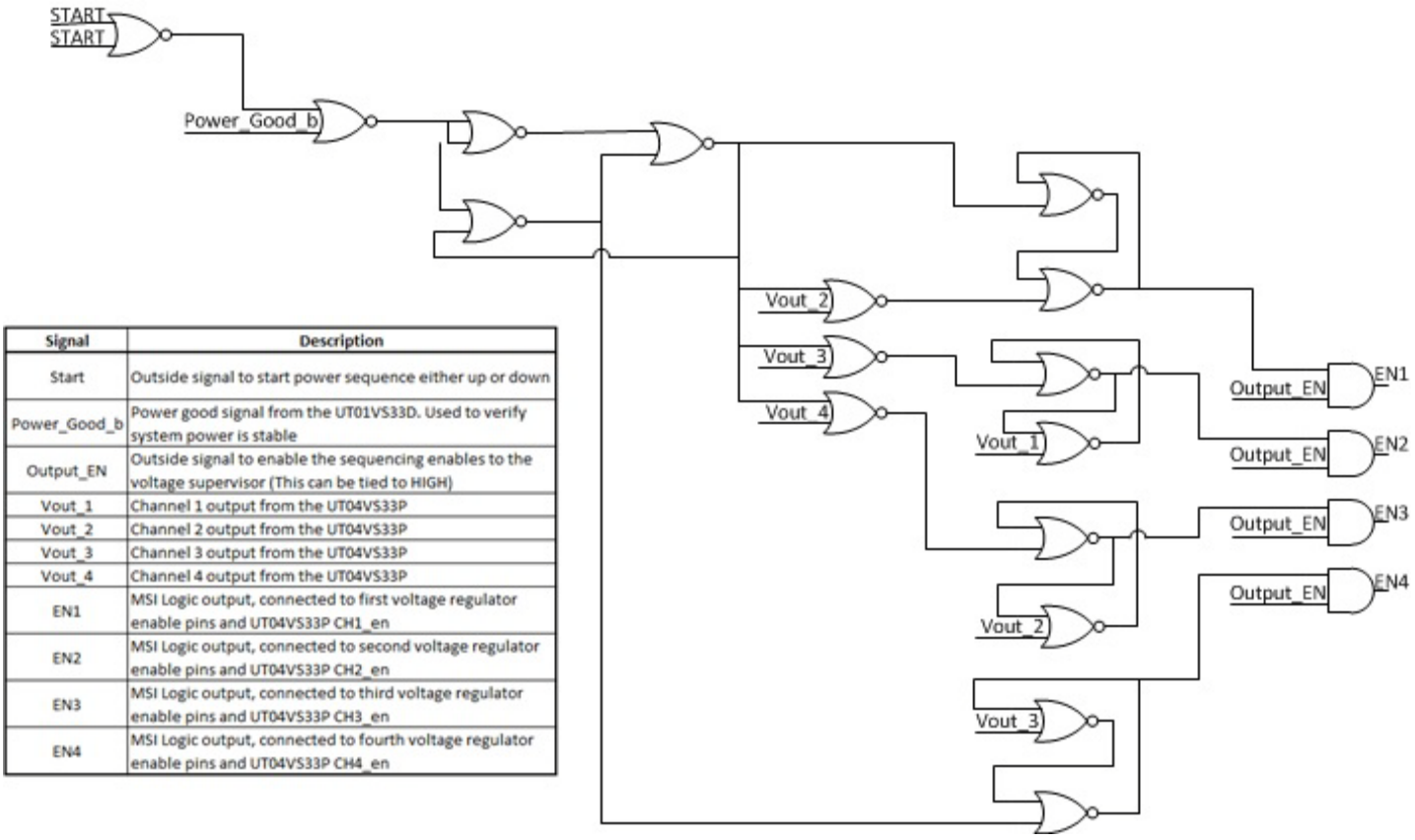


Figure 3. Demonstration Board Back (right)

3 Intelligent Power Sequencing Application

The Intelligent Power Sequencer uses a Cobham Single Channel Voltage Supervisor (UT01VS33D) to monitor a system-regulated, 3.3V rail. This creates a System Power Good (3.3v PWRGD) used to start the sequencer. The MSI logic combines with the START switch to initiate power up. Voltage comparators in the Quad Supervisor (UT04VS33P), create a series of enables to start the monitored voltages and sequence them up in an order of VOUT1, VOUT2, VOUT3, and then VOUT4. The comparators in the Quad Supervisor verify each voltage rail is within tolerance before enabling the next rail. Removing START causes the Quad Supervisor and MSI to disable the voltage regulators in the inverse order of power-up. If PWRGD faults, the logic disables each voltage rail in reverse sequence to start up. The Quad Supervisor disables each power rail as the logic waterfall occurs. This shutdown can occur in less than 16uS. However, using a series resistor to drive a grounded capacitor and the enable signals on the Quad Supervisor provides adjustable timings for both the power up and power down sequences to meet timing requirements of the system.



Signal	Description
Start	Outside signal to start power sequence either up or down
Power_Good_b	Power good signal from the UT01VS33D. Used to verify system power is stable
Output_EN	Outside signal to enable the sequencing enables to the voltage supervisor (This can be tied to HIGH)
Vout_1	Channel 1 output from the UT04VS33P
Vout_2	Channel 2 output from the UT04VS33P
Vout_3	Channel 3 output from the UT04VS33P
Vout_4	Channel 4 output from the UT04VS33P
EN1	MSI Logic output, connected to first voltage regulator enable pins and UT04VS33P CH1_en
EN2	MSI Logic output, connected to second voltage regulator enable pins and UT04VS33P CH2_en
EN3	MSI Logic output, connected to third voltage regulator enable pins and UT04VS33P CH3_en
EN4	MSI Logic output, connected to fourth voltage regulator enable pins and UT04VS33P CH4_en

Figure 4. MSI Logic Schematic

4 Conclusion

The Cobham UT04VS33P Quad Supervisor uses MSI logic to sequence voltage rails in any order with adjustable delays for each rail. This design provides a solution to FPGA and ASIC sequenced power-up and power down requirements. The power down sequences quick, which allows for emergency shutdowns. However, if power-down delays are necessary, a simple R-C delay connected to the voltage supervisor enable pins is feasible. Please see our Build of Materials (BOM) and schematics for full design reference.

Table 1. Reference Design BOM

FN	Qty.	Reference Designators	Part Number	Description	PKG	MFG
0	2	PWB	Sequenced Power PCB	PCB Board (Sierra)	4" x 4"	Sierra Circuits
1	6	C1,C9,C11,C13,C15,C17	TAJR104K020RNJ	CAP,TANT,0.1uF,20V,10%,0805	805	AVX Corporation
	Alt		478-3286-1-ND			DigiKey
2	5	C2,C18,C21,C22,C23	6TPU10MSI	CAP,TANT,10uF,6.3V,20%,0805	805	Panasonic
	Alt		P16224CT-ND			DigiKey
3	4	C3,C4,C5,C6	08055A561FAT2A	CAP,CER,560pF,50V,1%,0805	805	Kemet
	Alt		478-6047-1-ND			DigiKey
4	1	C7	C1608C0G1H680F080AA	CAP,CER,68pF,50V,1%,0603	603	TDK Corporation
	Alt		445-7029-1-ND			DigiKey
5	11	C8,C10,C12,C14,C16,C24,C25,C26,C,27,C28,C29	C0805C103F5GACTU	CAP,CER,0.01uF,50V,1%,0805	805	Kemet
	Alt		399-11161-1-ND			DigiKey
6	2	C30,C31	C1825C225J5RACTU	CAP,CER,2.2uF,50V,5%,1825	1825	Kemet
	Alt		399-10095-1-ND			DigiKey
7	4	D1,D2,D3,D4	LTST-C171GKT	Green_LED	805	Lite-On Inc
	Alt		160-1423-1-ND			DigiKey
8	3	J1,J2,J3	STC02SYAN	HEADER 2	2x1_header	Sullins Connector
	Alt		S9000-ND			DigiKey
9	6	J4,J5,J6,J7,J8,J9	575-4	Solder_Banana_Jack_Single	ban_jack_solder_575-4	KeystoneElectronics
	Alt		575-4K-ND			DigiKey
10	1	PB1	1.14100.5030000	Push_Button	sw_racon8smd	C&K Components
	Alt		CKN9363CT-ND			DigiKey
11	4	R1,R2,R5,R6	ERJ-6ENF1001V	RES,1K,1%,0.125W,0805	805	Panasonic
	Alt		P1.00KCCT-ND			DigiKey
12	5	R3,R9,R12,R15,R18	PLT0805Z2502AST5	RES,25K,0.05%,.25W,0805	805	Vishay Thin Film
	Alt		PLT0805-25KACT-ND			DigiKey
13	1	R4	ERA-6AEB2102V	RES,21K,0.1%,0.125W,0805	805	Panasonic
	Alt		P21KDACT-ND			DigiKey
14	3	R7,R10,R13	ERA-6AEB3571V	RES,3.57K,0.1%,0.125W,0805	805	Panasonic
	Alt		P3.57KDACT-ND			DigiKey
15	1	R8	ERA-6AEB1151V	RES,1.15K,0.1%,0.125W,0805	805	Panasonic
	Alt		P1.15KDACT-ND			DigiKey

Table 1. (Continued) Reference Design BOM

FN	Qty.	Reference Designators	Part Number	Description	PKG	MFG
16	1	R11	ERA-6AEB1691V	RES,1.69K,0.1%,0.125W,0805	805	Panasonic
	Alt		P1.69KDACT-ND			DigiKey
17	1	R14	ERA-6AEB2871V	RES,2.87K,0.1%,0.125W,0805	805	Panasonic
	Alt		P2.87KDACT-ND			DigiKey
18	1	R16	ERA-6AEB4121V	RES,4.12K,0.1%,0.125W,0805	805	Panasonic
	Alt		P4.12KDACT-ND			DigiKey
19	1	R17	ERA-6AEB4751V	RES,4.75K,0.1%,0.125W,0805	805	Panasonic
	Alt		P4.75KDACT-ND			DigiKey
20	1	R19	ERJ-3EKF1690V	RES,169,1%,0.1W,0603	603	Panasonic
	Alt		P169HCT-ND			DigiKey
21	1	R20	ERJ-3EKF1270V	RES,127,1%,0.1W,0603	603	Panasonic
	Alt		P127HCT-ND			DigiKey
22	1	R21	ERJ-3EKF90R9V	RES,90.9,1%,0.1W,0603	603	Panasonic
	Alt		P90.9HCT-ND			DigiKey
23	1	R22	ERJ-3EKF75R0V	RES,75,1%,0.1W,0603	603	Panasonic
	Alt		P75.0HCT-ND			DigiKey
24	10	R24,R26,R28,R30,R32,R34,R35,R36,R37,R38	ERJ-3EKF1002V	RES,10K,1%,0.1W,0603	603	Panasonic
	Alt		P10.0KHCT-ND			DigiKey
25	1	SW1	400BWMSP1R2BLKSM6QE	Rocker Switch	sw_400bwm	E-Switch
	Alt		EG4336CT-ND			DigiKey
26	1	U1	VRG8662	3_3_LDO	VRG8662	Cobham/Aeroflex
27	1	U2	UT01VS33D	Volt_Super_Single	cfp8p50mil	Cobham/Aeroflex
28	4	U3,U4,U5,U6	AP7173-SPG-13	AP7173_LDO	soic8_therm_pad	Diodes Inc.
	Alt		AP7173-SPG-13DICT-ND			DigiKey
29	4	U7,U8,U9,U10	UT54ACTS02E	MSI_Quad_NOR	cfp14p50mil	Cobham/Aeroflex
30	1	U11	UT54ACTS08E	MSI_Quad_AND	cfp14p50mil	Cobham/Aeroflex
31	1	U12	UT04VS33P	Volt_Super_Quad	cfp28p25mil	Cobham/Aeroflex

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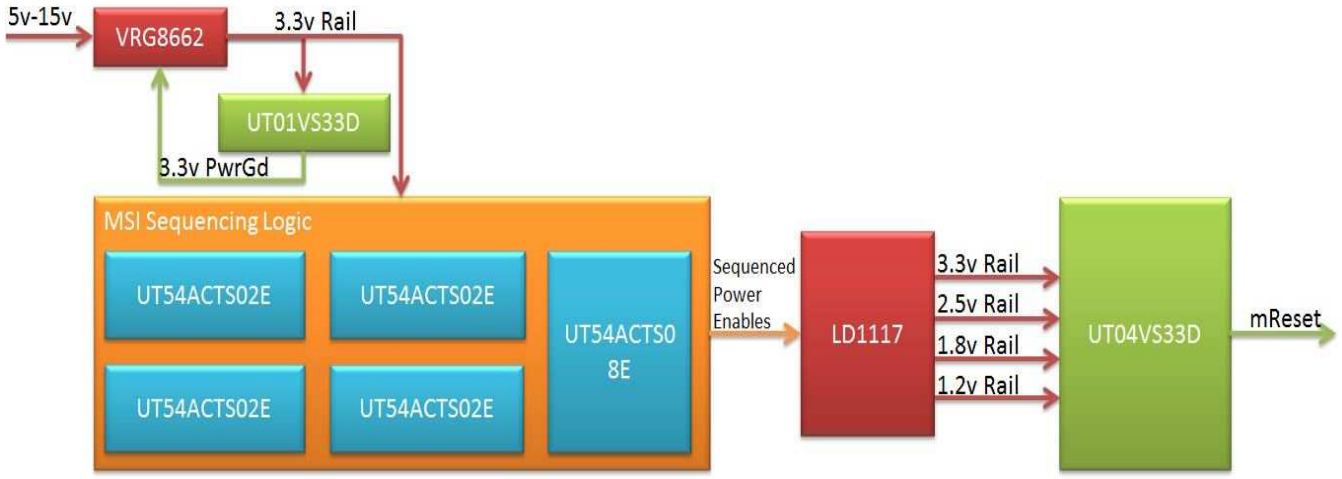

Notes:

Red text denotes layout instructions
Green text denotes silkscreen markings
Blue text denotes population options

Figure 5. System Block Diagram

Table 2. Board Specifications

Generic Specifications		
Board Dimensions	4" x 4"	
Board Maximum Weight	NA	
Number of Layers:	4	
Dielectric Material	FR-4	
Dielectric Thickness	<8 mil	
Outer Layer Copper Weight	1oz	
Inner Layer Copper Weight	1oz	
Differential Line Spacing	5 mil	
Default Trace Width	5 mil	
Voltage Rails	**Voltage**	**Current (amps)**
Input	15	1
Internal Rail 1	3.3	1
Output 1	3.3	0.8
Output 2	2.5	0.8
Output 3	1.8	0.8
Output 4	1.2	0.8
Layer Definition	**Name**	**Type**
Layer 1	Top	Sig/Pwr
Layer 2	GND 1	GND
Layer 3	GND 2	GND
Layer 4	BTM	Sig/Pwr

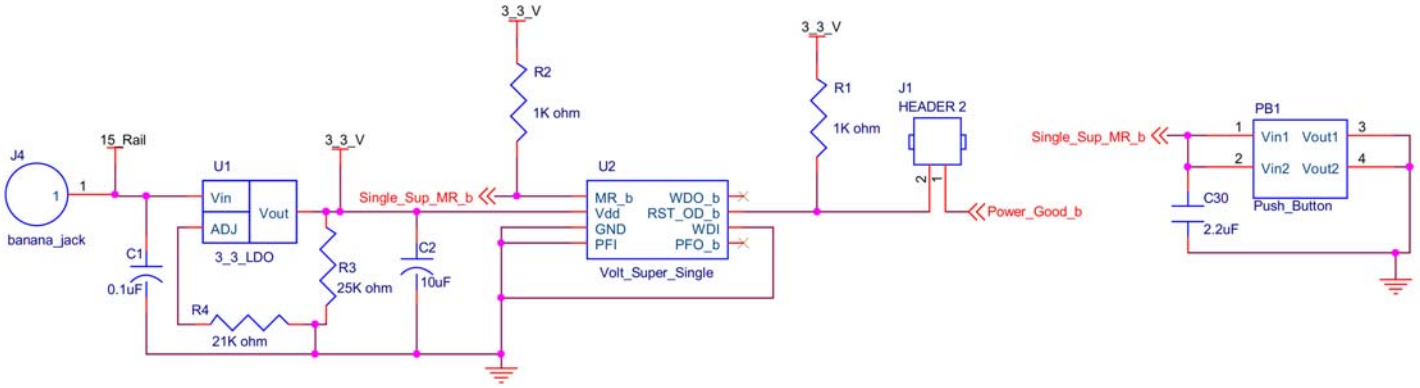

Figure 6. Schematic - Input Power

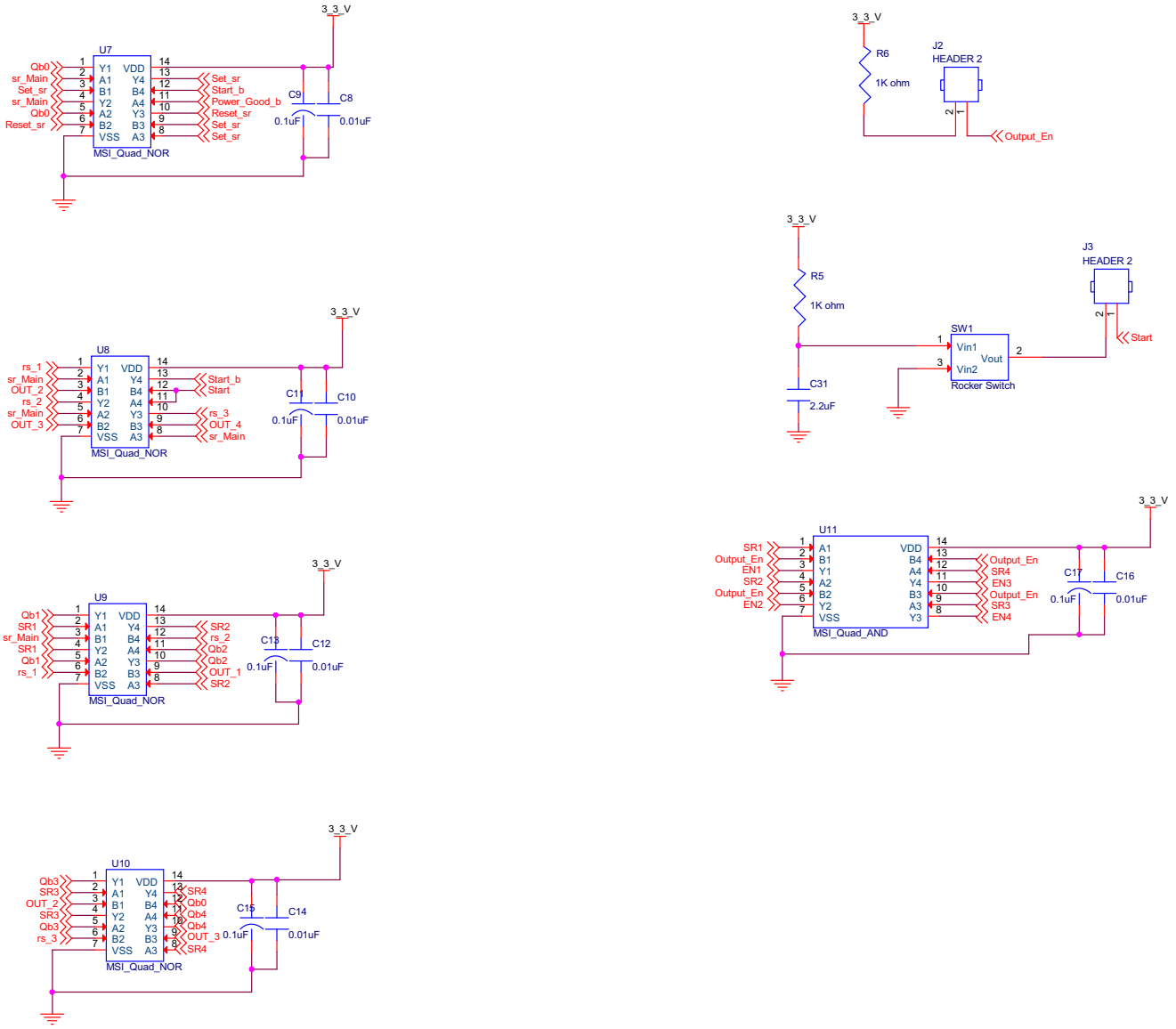

Figure 7. Schematic - MSI Logic

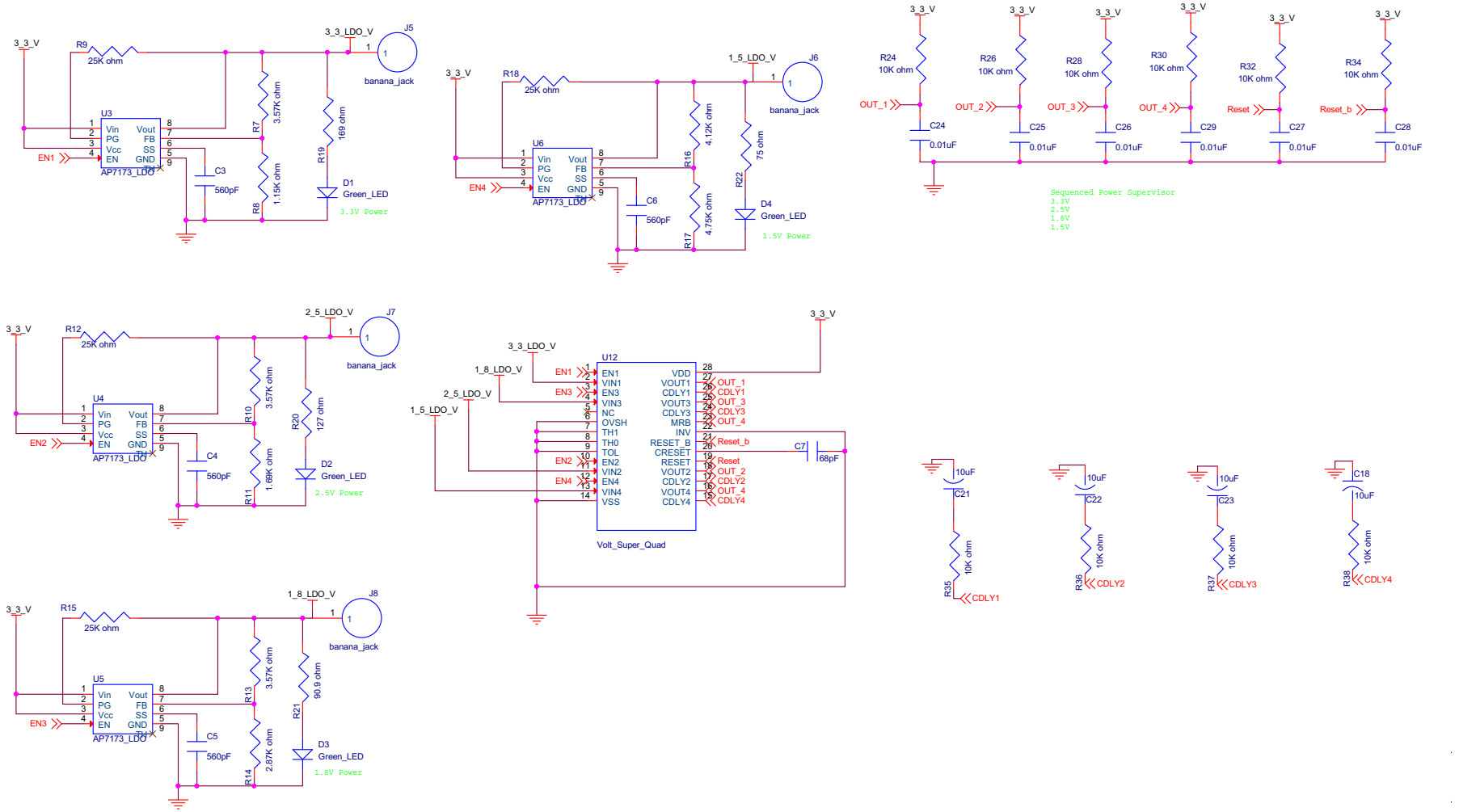

Figure 8. Schematic - Output Power

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